Title: The History of Mathematics: An Internet Approach

Brief Overview:

This unit is designed to be an enrichment project in Pre-Calculus, but could apply at almost any secondary level. Students will use school-provided Internet access to browse World Wide Web sites pertaining to the history of mathematics. The project is subdivided into two parts: 1. Learning to Explore, and 2. Surveying the People and Topics. An addendum, Women and African-Americans is available as an extension activity.   Each subdivision, and the addendum, can be utilized as a stand-alone investigation. The emphasis is on surveying available Internet resources pertaining to the history of mathematics. Several activities are included, but the teacher should feel free to utilize these resources in any way that will satisfy the needs of the particular class. The Internet resources included are appropriate for development of an interdisciplinary unit, possibly with social studies or English instructors.

Links to Standards:

- **Mathematics as Problem Solving**
  Students will investigate the historical problem-solving endeavors of the "masters" to investigate and understand mathematical content.

- **Mathematics as Communication**
  Students will read written presentations of mathematics with understanding; ask clarifying and extending questions related to mathematics they have read or discussed; appreciate the economy, power, and elegance of mathematical notation and its role in the development of mathematical ideas.

- **Mathematics as Reasoning**
  Students will study the structure and validity of logical arguments posed by the "masters."

- **Mathematical Connections**
  Students will study the connections among mathematical topics, and between mathematics and other disciplines.

Grade/Level:

Grades 9-12

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Accessing the Internet connection on their school's network
- Using a WWW browser, such as Netscape or MS Internet Explorer, to browse pages and sites, to capture text and graphics files, and to save whole pages for local browsing
- Composing a word-processed document, including imbedding a graphic file

Objectives:

Students will:

- navigate World Wide Web pages and sites.
- collect and organize content obtained for WWW resources in short response and expository modalities.
- evaluate the content, organization, usefulness, appearance, and ease of access of WWW resources.

Materials/Resources/Printed Materials:

- Internet access, including a WWW browser such as Netscape.
- Word processor with the capability of imbedding and displaying graphics files, such as MS Word.

Teacher Resources:

- Part I Learning to Explore
  - Web page text and html source code
  - Activity A: A sample scavenger hunt
  - Activity B: A student scavenger hunt (pairs activity)
- Part II Surveying the People and Topics of the History of Mathematics
  - Web page text and html source code
  - Activity A: Research paper
  - Activity B: Page/Site rating
  - Activity C: Student math history page (optional)
- Addendum Women and African-Americans in Mathematics
  - Web page text and html source code

Development/Procedures:

1. Browse ten math history WWW pages/sites of an introductory nature with reference to mathematics history, answering the scavenger hunt queries.

2. Working in pairs, develop a virtual scavenger hunt using at least five of the ten pages/sites from step 1.

3. Write a research paper using ten pages/sites. These resources are of an archival nature, and are different than those used in the scavenger hunt.

4. Rate five of the ten pages/sites from step 3.

5. (Optional) Compose a math history web page.

Performance Assessment:

1. Scavenger hunt may be scored on content.

2. Student-developed hunt can be self-assessed, peer-assessed, and/or scored by a rubric based on participation, originality, and reasonableness of content.

3. Research paper is scored on a rubric based on fulfilling criteria given, content, use of resources, and originality.

4. Site ratings are scored on a participation basis.

5. Optional web page composition can be peer-assessed or scored on a rubric similar to the one applied to the research paper.

Extension/Follow Up:

The URL's provided give a wealth of source material for additional activities. E-mail exchange with other schools working with the same pages/sites is a worthwhile possibility. In addition, five sites relating to women and African-Americans in mathematics have been provided in the Addendum.

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Part I: Learning to Explore

1. http://www.maa.org/mathland/mathland_1_20.html
"Fragments of the Past," by Ivars Peterson

2. http://www-groups.dcs.st-and.ac.uk:80/~history/HistTopics/History_overview.html
An Overview of the History of Mathematics

3. http://members.aol.com/jeff570/mathword.html
Earliest Known Uses of Some of the Words of Mathematics

4. http://members.aol.com/jeff570/mathsym.html
Earliest Uses of Various Mathematical Symbols

5. http://www.maa.org/mathland/mathland_8_5.html
"Old and New Arithmetic," by Ivars Peterson

6. http://insci2.ucsd.edu/~fillmore/blurbs/numbsys.html
History of Numeral Systems

7. http://hanksville.phast.umass.edu/yucatan/mayamath.html
Mayan Math

8. http://www.comlab.ox.ac.uk/oucl/users/jonathan.bowen/algebra/
A Brief History of Algebra and Computing

9. http://www.lib.virginia.edu/science/parshall/algebra.html
The Art Of Algebra From al-Khwarizimi to Viete

10. http://bondo.wsc.mass.edu/dept/math/faculty/fleron/quotes/quohome.htm
Mathematics and Education Quotation Server

Part I: Learning to Explore   -   HTML source code

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<HEAD>
<TITLE>Part I:  Learning to Explore</TITLE>
</HEAD>
<BODY>
<h1>Part I:  Learning to Explore</h1>

<a href="http://www.maa.org/mathland/mathland_1_20.html">1.
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A Brief History of Algebra and Computing

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<a href="http://bondo.wsc.mass.edu/dept/math/faculty/fleron/quotes/quohome.htm">10. http://bondo.wsc.mass.edu/dept/math/faculty/

Part I: Learning to Explore

A.   A Sample Scavenger Hunt
        Visit each page or site given on the Learning to Explore page and respond to queries as
        you explore each page. (Teacher's Note: The most promising vehicle to capture these
        responses would be in a word-processing file, preferably a file of these questions.)

    1. After reading "Fragments of the Past," summarize the Islamic mathematicians in
        furthering European mathematics.

    2. Go to "An Overview of the History of Mathematics" and follow the links to capture
        the graphic files depicting:

        a. The Circles of Apollonias,
        b. The Portrait of Galileo Galilei,
        c. Newton's Method
        d. Any birthplace map

    3. What is a grad, and when was it first used in mathematics?

    4. It is believed that William Jones first used the symbol Π (pi) in 1706 in *Synopsis
        Palmariorum Mathesios* because _____

    5. What is *Treviso Arithmetic* that Ivars Peterson discusses in "Old and New
        Arithmetic?"

    6. What world cultures are represented in "History of Numeral Systems," by Chanie
        Welch?

    7. The Mayans devised a counting system to represent very large numbers. Show these
        symbols and the Mayan representation for the number 2,677.

    8. What is Boolean Algebra, who first formalized its rules, and what was the alias of
        Charles Lutwidge Dodgson?

    9. Save the page "The Art of Algebra" to a 3.5 floppy so that you can access it locally
        for later study.

    10. Write your favorite mathematics "quote of the day" and the name of the author.

B. A Student Scavenger Hunt - Pairs Activity
   Develop a virtual scavenger hunt of your own using the following criteria:

   - Work with a partner
   - Use at least five of the ten sites
   - The hunter should be required to explore several levels within a site, when possible.
   - Pose at least ten questions, maintaining a reasonable balance among the thinking skill levels from short answer/completion to application/ analysis.
   - Questions should appear in one file or page, and expected responses in another. Include the appropriate URL with each response.
   - Questions will be exchanged with another pair within their class or another class working on the same project.
   - Upon completion each pair will submit their questions, responses, the peer exchange results, and a peer evaluation of your hunt.

A Sample Scavenger Hunt - Answer Key

1. After reading "Fragments of the Past," summarize the Islamic mathematicians in furthering European mathematics.

    Answers will vary - Key Idea (from page):
    Historians of mathematics now generally agree that scholars in China, India, and the Islamic world produced remarkably sophisticated mathematics during this period. However, most would probably still argue that Europeans in later centuries were unaware of this work and made advances with minimal help from the earlier
    efforts.

    Careful detective work now hints that significant ideas in several areas of mathematics -- trigonometry, non-Euclidean geometry, number theory, and combinatorics -- were in fact transmitted from the Islamic world in time for them to play crucial roles in furthering European mathematics.

2. Go to "An Overview of the History of Mathematics" and follow the links to capture   the graphic files depicting:
    a. The Circles of Apollonias,
       See http://www-groups.dcs.st-and.ac.uk:80/~history/BigPictures/ApolloniusTheorem.gif
    b. The Portrait of Galileo Galilei,
       See http://www-groups.dcs.st-and.ac.uk:80/~history/BigPictures/Galileo.jpeg
    c. Newton's Method
       See http://www-groups.dcs.st-and.ac.uk:80/~history/BigPictures/NewtonMethod.gif
    d. Any birthplace map
       Eg.: http://www-groups.dcs.st-and.ac.uk:80/~history/BirthplaceMaps/Places/Woolsthorpe.html

3. What is a grad, and when was it first used in mathematics?

    GRAD (for gradient) is found in 1909 in Vector Analysis by J. G. Coffin. This is the earliest citation in the Oxford English Dictionary; earlier uses for this
    symbol may exist.

4. It is believed that William Jones first used the symbol Π (pi) in 1706 in *Synopsis Palmariorum Mathesios* because _____

    PI FOR 3.14159... was first used by William Jones (1675-1749) in 1706 in Synopsis Palmariorum Mathesios. It is believed he used <u>because it is the first letter in perimetron, the Greek word for</u>
    <u>perimeter.</u>

5. What is *Treviso Arithmetic* that Ivars Peterson discusses in "Old and New Arithmetic?"

   This problem appears in a <u>mathematics textbook</u> known as the Treviso Arithmetic. The original book, written in a Venetian dialect, had no formal title, and its author is unknown. Treviso is the northern Italian city where the book originate in 1478.

6. What world cultures are represented in "History of Numeral Systems," by Chanie Welch?

   Babylonian, Egyptian, Chinese, Greek, Roman, and Persian

7. The Mayans devised a counting system to represent very large numbers. Show these symbols and the Mayan representation for the number 2,677.

   See http://hanksville.phast.umass.edu/yucatan/mayamath.html. Use the characters for 2400, 260, and 17 given in the displayed example to represent 2,677.

8. What is Boolean Algebra, who first formalized its rules, and what was the alias of Charles Lutwidge Dodgson?

   Boole's aim was to identify the rules of reasoning in a rigorous framework and revolutionized formal logic after thousands of years of little progress. They transformed logic from a philosophical into a mathematical discipline. These rules have subsequently become known as Boolean algebra and the design of all modern binary digital computers has depended on the results of this work. These logical operations, normally implemented as electronic gates, are all that are required to perform more complicated operations such as arithmetic.

   Charles Lutwidge Dodgson is a psuedonym used by Lewis Carroll, author of Alice in Wonderland

9. Save the page "The Art of Algebra" to a 3.5 floppy so that you can access it locally for later study.

   Check with browser locally...

10. Write your favorite mathematics "quote of the day" and the name of the author.

    Answers will vary.

Part II: Surveying the People and Topics of the History of Mathematics

1. http://www-groups.dcs.st-and.ac.uk:80/~history/HistoryTopics.html
Topics Index

2. http://aleph0.clarku.edu:80/~djoyce/mathhist/mathhist.html
Topics and Biographies...clickable timelines, regional maps

3. http://archives.math.utk.edu/topics/history.html
All-purpose

4. http://www.gre.ac.uk/~aj434/
Overviews of 17th, 18th, and 19th centuries - biographies

5.http://www.ncsa.uiuc.edu/SDG/Experimental/vatican.exhibit/exhibit/d-mathematics/
Greek_math.html
Ancient Greeks - Original work (manuscripts) of Euclid, Archimedes, Appolonius, Ptolemy on
display

6. http://www.siue.edu/~dcollin/mathfame.html
Alphabetical index of Biographies

7. http://www.shu.edu/~wachsmut/reals/history/
Historical "tidbits" for 12 mathematicians, including Archimedes, Bernoulli, Cantor, Euclid, and
Euler

8. http://galileo.imss.firenze.it/museo/b/index.html
Italian server with alphabetized index of biographies

9. http://www.math.uga.edu/~ntheory/N14.html
A few biographies

10. http://www.seanet.com/~ksbrown/ihistory.htm
Index of topics

Part II: Surveying the People and Topics of the History of Mathematics   -   HTML source
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<ahref="http://www.ncsa.uiuc.edu/SDG/Experimental/vatican.exhibit/exhibit/d-mathematics/Greek_math.html">5. http://www.ncsa.uiuc.edu/SDG/Experimental/vatican.exhibit/exhibit/d-mathematics/Greek_math.html
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<a href="http://www.seanet.com/~ksbrown/ihistory.htm">10. http://www.seanet.com/~ksbrown/ihistory.htm
Index of topics
<

Part II: Surveying the People and Topics of the History of Mathematics

A. Research Paper
   Write a paper using the ten pages or sites provided in the Surveying the People Topics
   provided.

   Suggestion for scope:

   - Investigate a group of mathematicians such as the ancient Greeks.
   - Explore the life and works of a single mathematician such as Isaac Newton.
   - Analyze a time line, such as 1800 to 1940 which is roughly the scope of the Industrial
     Revolution.
   - Dissect a topic or group of related topics, such as infinity or algebra.

   Criteria:

   - The paper should be three to five typewritten pages (excluding graphics), approximately
     1000 words.

   - Inclusion of graphics is encouraged. Be certain that no copyrights are violated, however.

   - The paper should reference at least five of the pages/sites provided.

B. Page/Site Rating
   Rate five of the ten pages/sites on a scale of 1 to 5 for each of the following criteria:

   - content
   - organization
   - usefulness
   - appearance
   - ease of access

   Include a paragraph (a few sentences) giving your overall impression of your selected
   pages/sites.

   Special Note: Please include in this section any new pages or sites that you think should be
   included in this collection.

C. Student Math History Page
   Compose your own math history page. This html document should have formatted text,
   on to three graphics, and at least one clickable link to another non-local page or site.

Addendum: Women and African-Americans in Mathematics

Women

1. http://www.scottlan.edu/lriddle/women/women.htm
Biographies in Chronological and Alphabetical Order

2. http://www.cs.yale.edu/homes/tap/past-women-cs.html
Women in Computing

3. http://www.teleplex.bsu.edu/home/nshadle/web/wmmain.htm
Alphabetical listing of links to source info pertaining to women in mathematics

African-Americans

1. http://www.math.buffalo.edu/mad/mad0.html
Mathematicians of the African Diaspora, pages include The Ancients, Modern Historical
Significance, Outside North America, Black Research Mathematicians,
and Profiles of Black Mathematicians

2. http://forum.swarthmore.edu/dr.math/problems/dean11.7.96.html
Text and links for African-Americans in mathematics

Addendum: Women and African-Americans in Mathematics -   HTML source code

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<TITLE>Addendum:  Women and African-Americans in Mathematics</TITLE>
</HEAD>
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<h1>Addendum:  Women and African-Americans in Mathematics</h1><br>
<h2>Women</h2>

<a href="http://www.scottlan.edu/lriddle/women/women.htm">1.
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http://www.cs.yale.edu/homes/tap/past-women-cs.html<br>Women in Computing<br></a><br>
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<a href="http://www.teleplex.bsu.edu/home/nshadle/web/wmmain.htm">3.
http://www.teleplex.bsu.edu/home/nshadle/web/wmmain.htm<br>Alphabetical listing of links to
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Mathematicians, and Profiles of Black Mathematicians<br></a><br>

<a href="http://forum.swarthmore.edu/dr.math/problems/dean11.7.96.html">2.
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